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THE RESPIRATORY TRACT IN HEALTH AND DISEASE *

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GENERAL CONSIDERATIONS.—Animals and plants require solid, liquid, and gaseous food. Plants derive their sustenance from the various salts and the moisture found in the soil, and from the carbonic acid gas, moisture, and oxygen of the air. Animals, besides solid and liquid food, must have oxygen from the air. Without oxygen animals die in a few minutes; without food they can live hours.

Respiration.—The purpose of respiration is to bring oxygen to the tissues of the body, and to remove the carbonic acid gas. It is necessary to have oxygen brought into intimate relation with the circulating medium, that an interchange of gases may take place. This is accomplished in various ways in different animals. All the tissues of the human body are composed of cells, such as, muscle, nerve, glandular, and many other varieties. Each cell, like the amœba, is composed of a little mass of protoplasm, which is nourished by the oxygen and other substances obtained from the blood as it circulates through the tissues; thus we see that respiration proper is carried on in the tissues themselves, and the upper air-passages, lungs, and the blood are merely the carriers of the oxygen to the tissues.

COMPARATIVE STUDY OF BREATHING IN THE LOWER ANIMALS.—*Protozoa.*—This class, of which the amœba is a type, is the lowest form of animal life. The amœba is a single-celled animal composed of a little mass of protoplasm. It absorbs all of its food, including the oxygen, through the surface of the body. It has no differentiated organs of respiration.

Aquatic Animals.—These animals must obtain their supply of oxygen from the air dissolved in the water. All water in the natural condition contains oxygen, but if the water is boiled, the air, with the oxygen, is driven off; therefore, aquatic animals cannot live in boiled water. Examples: sponges, fishes. Sponges have no specialized organs of respiration, or digestion. Numerous small pores on the surface conduct the current of water to cavities in the body of the sponge. The current of fresh water for respiratory purposes and for food is produced

* Summary of a course of lectures given to the pupil nurses of Farrand Training School, Detroit.

by the cilia lining the small cavities. The current leaves the body through an exhalant aperture (oscula).

Fishes breathe by means of gills. The gills are situated just behind the mouth, so that the current of water, bearing the oxygen, passes through the slits in the back wall of the mouth to the delicate branchial leaflets. The blood, circulating in the minute capillaries in the leaflets, takes the oxygen from the water and gives to it carbonic acid gas. The gills, in order to absorb oxygen, must be kept moist, so a fish in the air soon dies from the drying of the branchial leaflets.

AMPHIBIANS.—These animals are able to live both on land and in the water. Example, frogs. Frogs, in the tad-pole stage, breathe by gills, as fishes do, but the adult frog has lungs. The frog also has the power of absorbing oxygen through the moist surface of the skin. This is the reason they are often seen after a rain.

LAND ANIMALS.—The majority of these animals have specially constructed organs inside of the body, so that the blood can be brought into close contact with the oxygen of the air; a few have a delicate, moist skin for breathing purposes. Earth-worms breathe through the moist surface of the skin, therefore, it is impossible for them to live long in dry air. This accounts for the appearance of earth-worms on the surface of the ground after a warm rain.

Insects, as a rule, live in dry air, and must have their organs of respiration inside of the body to protect them from dessication. Their respiratory organs consist of numerous fine air-tubes, which extend along the whole length of the body, and ramify like a tree into finer and finer branches. The gaseous interchange occurs in the finest ramifications.

Reptiles are cold-blooded animals with slow respiration and circulation as compared with birds and mammals. Reptiles can live a long time without breathing, are more active in warm weather, and thrive in hot dry climates. The snake's lung consists of a long membranous sac, which extends along the whole length of the body, and contains in its posterior portion a sufficient store of respiratory air.

Birds have lungs, but in addition they have air-sacs permeating different portions of the body, which give them a supply of reserve air. These air-sacs are automatically filled during flight by the pressure of the air, and the movement of the wings helps to pump out the air; thus birds have this reserve power in addition to the usual method of breathing by the lungs. This explains why birds are never out of breath after a long flight.

MAMMALS (HIGHER ANIMALS AND MAN).—The current of air passes through the following organs to reach the air-cells: 1, nose, 2, naso-

pharynx (vault) ; 3, pharynx (throat) ; 4, larynx (voice-box) ; 5, trachea (windpipe) ; and 6, bronchi to the air-cells of the lungs.

ANATOMY AND PHYSIOLOGY OF THE NOSE.—The two nasal passages open forward on the face and behind into the nasopharynx, and are formed by bones and cartilages, which constitute the framework. The septum forms the inner wall of each passage, the turbinals the outer. The turbinals are scroll-shaped bones, covered by a thick mucous membrane, which is very rich in blood-vessels and lymph-channels. There are three turbinals: upper, middle, and lower.

Sinuses.—There are a number of bony cells, lined by mucous membrane, adjoining the nose, which are known as accessory sinuses. They communicate by small openings with the cavity of the nose. These sinuses are: 1, maxillary (antrum) ; 2, ethmoid cells ; 3, frontal ; 4, sphenoid. Diseases of the nose may extend to any of the sinuses. If the openings from the sinuses into the nose are closed from inflammatory swelling, pressure of tumors, or from other causes, serious results may follow.

FUNCTIONS OF THE NOSE.—1, breathing ; 2, smell ; 3, voice. The air as it passes through the nose is warmed, moistened, and filtered. Obstruction of the nose leads to mouth breathing, which is very injurious as the mouth cannot warm, moisten, and filter the air as it enters the lungs.

Smell.—The nerves of smell are distributed over the upper portion of the nose. The sense of smell is not nearly so highly developed in man as in some of the lower animals, such as, the dog, deer, and the bear.

Voice.—The nose and the sinuses act as resonators, and play an important part in the production of certain articulate sounds. (See voice.)

ANATOMY AND PHYSIOLOGY OF THE NASOPHARYNX (VAULT OF THE THROAT).—This dome-shaped cavity is bounded behind and above by the base of the skull and the vertebral column ; in front by the nose ; on each side by the Eustachian tubes, which connect the throat with the middle ear ; and below it connects with the pharyngeal cavity at the level of the soft palate. The vault contains normally lymphoid (adenoid) tissue, which often becomes enlarged in children. The middle ear may become diseased through the extension of the inflammation, or infection, into the Eustachian tubes, from the throat.

ANATOMY AND PHYSIOLOGY OF THE PHARYNX (THROAT).—The pharynx extends from the nasopharynx, above, to the upper border of the larynx below. It is bounded behind by the vertebral column, and the muscles and the soft parts covering it ; on each side by the muscles of the pharynx ; and in front it connects with the mouth, or buccal

cavity. The pillars of the fauces and uvula mark the division between the pharynx and the buccal cavity. The points of interest are: soft palate and uvula; pillars of the fauces; tonsils. The soft palate, uvula, and the anterior and posterior pillars are muscular in structure.

The tonsils lie in a recess between the anterior and posterior pillars, and are composed of lymphoid tissue, similar in structure to the adenoid tissue of the vault. Normally the tonsils are not visible on ordinary inspection of the throat. When the tonsils are readily seen it is a sign that they are abnormally large.

Lingual Tonsils.—At the base of the tongue, on either side of the median line, is a small amount of lymphoid tissue, known as the lingual tonsil. Hypertrophy of the lingual tonsil is more common in adults than in children, while the reverse is true in the case of the faucial tonsils.

ANATOMY AND PHYSIOLOGY OF THE LARYNX (VOICE BOX).—The larynx is formed by cartilages which, at the points of union, form true joints, and are held together by ligaments. The movements of the cartilages upon one another are affected by numerous small ligaments. The cartilages that can be readily felt in the neck, and which give form to the larynx, are the large thyroid above, and the smaller ring cartilage below. The Adam's apple is the prominent anterior edge of the thyroid cartilage. It is more prominent in males than in females.

The hyoid bone is a horse-shoe shaped bone, situated above the thyroid cartilage, and held in position by numerous muscles and ligaments.

The epiglottis is a leaf-shaped fibrocartilage, placed behind the base of the tongue, and during the act of swallowing it assists in closing the upper opening of the larynx.

The vocal cords consist of two pairs: the upper, or false; the lower, or true. The cords are parallel to one another and extend across the larynx from before backwards. The false cords (ventricular bands) are merely folds of mucous membrane, which lie above the true cords, and form the upper border of the ventricle of the larynx. The true cords are musculo-fibrous, which produce the voice when they vibrate. The ventricle of the larynx is the elliptical space between the false cords above, and the true cords below. It allows room for free movement of the cords. At the upper orifice of the larynx there are muscles arranged in the form of a sphincter which, by their contraction, help to close the orifice of the larynx during the act of swallowing.

The vocal cords are moved by muscles in three ways: 1, abduction; 2, adduction; and 3, tension. Abduction, or separation of the cords, allows the air to enter the lungs with each inspiration; adduction, or

the approximation of the cords, occurs when the voice is produced; and tension is necessary to give the different degrees of pitch to the voice.

The vocal organ is a flexible reed instrument, with the chest as the bellows; the larynx as the reed; and the nose, throat, and sinuses as the resonators. The intensity depends upon the blast from the chest; the pitch depends upon the vocal cords; and the quality depends upon the resonators. The pitch of the voice is the same for both sexes during childhood, but as puberty approaches a change takes place, due to the increase in the size and the shape of the larynx. The change is more notable in the male; the voice becomes lower in pitch and coarser in quality.

VOICE AND SPEECH.—“Voice is a column of breath set in vibration by its own impact with the vocal bands, and reinforced by its diffusion through the various resonators into the surrounding atmosphere” (G. Hudson-Makuen). Speech is articulate voice. Two mechanisms enter into the production of speech, first, the vocal bands and the respiratory organs below; second, the upper portion of the larynx, pharynx, palate, tongue, teeth, and lips. The resonators may be regarded as belonging to both mechanisms, for they are used to reinforce the primary tones of the voice, and also to give each vowel sound its characteristic quality.

The pronunciation of the various letters requires a definite position of the vocal organs. The position is always the same for a given letter. If there is nasal obstruction, cleft-palate, enlarged tonsils, or other abnormal condition, speech is affected. Defects in speech may be due to a number of causes; as, 1, lack of mental development, feeble minded and idiots; 2, lack of development of the vocal organs, hare-lip, cleft-palate, etc.; 3, pathologic conditions in the nose and throat, polypi, enlarged tonsils, adenoids; 4, lack of nervous control, stammering and stuttering; 5, ignorance, carelessness, and lack of education.

Congenital deafness, or deafness acquired early in life, is the usual cause of deaf-mutism. These patients can be taught to understand by reading of the lips. There is a close relation between the sense of hearing and the sense of speech. The musical quality of the speaking voice depends largely upon the acuteness of the subjective sense of hearing. Breath control is *the* important factor in the proper use of the voice, and should be mastered by every public speaker and singer.

LUNGS.—The lungs are divided into three right and two left lobes. The pleura lines the inner surface of the chest, and covers the outer surface of the lungs. The apposing surfaces are moist to prevent friction. The lobes are divided into lobules, and the lobules contain the smallest divisions of the bronchi, and the air-cells. The trachea, or windpipe,

divides into the right and the left bronchi. Each of these bronchi divides and subdivides into smaller and smaller bronchi until the air-cells are reached. The trachea and bronchi can be compared to an inverted tree and its branches.

Capacity of the Lungs.—Breathing, or tidal air, 25 cu. in.; complementary air, 100 cu. in.; reserve air, 100 cu. in.; respiratory capacity, 225 cu. in.; residual air, 100 cu. in.

The above figures are approximate only. Respirations, per minute, 14 to 18. Relation to pulse, 1 to 4, or 1 to 5. Rate of respiration varies greatly in different animals.

Composition of the Atmosphere.—Nitrogen, 79 parts; oxygen, 21 parts. Carbonic acid gas about 1 to 2000 parts by volume. Variable amount of moisture.

The blood, circulating in the walls of the air-cells, comes in close contact with the air. The blood takes the oxygen from the air and gives to the air the carbonic acid gas. The oxygen goes to nourish the tissues, and the carbonic acid gas is expelled from the body in the expired air.

DISEASES OF THE RESPIRATORY TRACT.—*General Considerations.*—Most of the diseases are due to infections, and may affect any portion of the respiratory tract. Thus we have rhinitis, pharyngitis, tonsillitis, laryngitis, and bronchitis.

Catching cold is due to a disturbance of the circulation which causes congestion, lowers resistance, and allows germs in the circulation, or on the mucous membrane, to develop. There are very few, if any, germs on the healthy bronchial mucous membrane, but in disease a large number are found. Chilling of one portion of the body often causes congestion of another portion, hence, wet feet, draughts, etc., act as predisposing causes of colds.

General Measures against Catching Cold.—Dress warmly, but do not bundle the neck with furs. Sleep in the fresh air. The living rooms should not be over 70°. Keep the stomach and bowels in good condition. Avoid damp feet and exposure. Breathe through the nose, not through the mouth. If nasal breathing is not possible all the time, something is wrong and should be corrected.

NASAL OBSTRUCTION.—An important cause of many catarrhal affections leads to impairment of health by interfering with free nasal breathing and oxygenation of the blood. Some of the frequent causes of nasal obstruction are: swelling of the mucous membrane and hypertrophy of the turbinal bodies; polypi and tumors; deformities of the nose, especially the septum.

Adenoids, very common in children, cause interference with free

breathing by obstructing the vault of the pharynx. They lead to mouth breathing, ear disease and deafness, frequent colds, impaired general health and mental power. Removal of the adenoids improves promptly the local and general conditions.

ACUTE TONSILLITIS.—Acute infection of the tonsils accompanied by pain, fever, difficulty in swallowing, etc. It is often followed by rheumatism, or infection of other organs. Treatment includes, besides drugs and local applications, rest in bed and soft diet.

ENLARGED TONSILS.—General infection often enters the body through the tonsils, and leads to rheumatism, heart disease, tuberculosis, and pleurisy. They may do harm also because of their size interfering with swallowing, free breathing, or influencing the voice. They cause chronic congestion, with catarrhal symptoms in the throat.

DIPHTHERIA.—An acute infectious disease, usually involving the tonsils and the adjacent parts.

PERITONSILLAR ABSCESS (QUINSY).—Infection through the tonsil, with abscess formation behind the tonsil. Prominent symptoms are: swelling, fever, difficulty in swallowing and pain. Often occurs in rheumatic subjects, with enlarged or diseased tonsils.

HAY FEVER (A NEUROSIS).—Three important causative factors: 1, nervous predisposition; 2, pollen of certain plants, as an exciting cause; 3, abnormal nose. Other reflex irritations are possible factors. Treatment: correct any abnormal condition of the nose; avoid irritating pollens as far as possible; and improve nervous stability.

HOARSENESS.—This symptom is common to most laryngeal diseases, such as, laryngitis, tumors, tuberculosis, malignant disease, paralysis of the cords, etc. It is also due to excessive or improper use of the voice. Voice tire (laryngeal fatigue) is common in those who use their voices considerably and are not strong.

ASTHMA (A NEUROSIS).—Varieties: 1, bronchial; 2, spasmodic; 3, cardiac; 4, renal. Cardiac and renal are secondary to heart and kidney diseases.

Bronchial.—In this form there is a chronic bronchitis all of the time, with acute spasmodic attacks at varying intervals.

Spasmodic.—Many exciting causes, as, nasal obstruction, constipation, certain articles of diet; occasionally reflexly from certain diseases of the stomach, bowels, rectum, and pelvis. By far the most important cause is improper breathing through the nose. Treatment: prophylactic,—free nasal breathing, diet, regular habits, etc. Medicinal,—morphine, iodides, inhalations, etc.

PNEUMONIA.—An acute infectious disease, accompanied by consoli-

dation of a portion of the lungs. There is marked prostration, high fever, rapid breathing, and some cough. The recovery of the patient in a serious case depends largely upon the nursing. The patient should be kept absolutely quiet in bed, in a quiet, well-ventilated room. Avoid all unnecessary handling or moving of the patient. The windows of the room should be wide open, even in cold weather, to allow an abundance of fresh air. Fresh air during the whole course of the disease lessens the fever, improves the breathing, allays restlessness, and obviates the necessity of inhalations of oxygen. Nourishment should be given regularly. Fluid or soft diet.

PLEURISY.—An inflammation of the covering of the lung. Similar care to a pneumonic patient.

GENERAL DIRECTIONS FOR THE CARE OF PATIENTS WITH DISEASES OF THE RESPIRATORY TRACT.—Patients with acute diseases should be in bed as long as there is fever, in comfortable, quiet, well-ventilated room. They should always have abundance of fresh air. The bowels should be kept open, the diet should be a simple one. Mouth, nose, and throat should be cleansed with a simple alkaline wash as often as necessary, to lessen the danger of infection of the ears, or the sinuses of the nose.

In some diseases of the throat, and after tracheotomy the air should be warm and moist. Methods of securing moisture: 1, placing of a shallow pan of water on a stove, register, or radiator; 2, attaching a funnel by means of rubber tubing to a tea-kettle; 3, very hot bricks, or flat irons in a basin of water. The steam may be confined to the area over the patient by an umbrella, draped with a sheet. This serves very well as an improvised croup tent. Care should be taken to allow plenty of fresh air, and never wet the patient, or his clothes by the condensing steam.

The severe sore throat of quinsy, or tonsillitis, is relieved by douching the throat every hour, or two, with a hot saline solution. Method of douching the throat: attach drinking tube, bent at an angle of 45°, to the rubber tube connected with an irrigating can, or fountain syringe. Do not place the container more than 1 foot above the head of the patient, as a strong stream is painful. Have patient sitting, with head bent forward, or with head over side of the bed. Allow the stream to enter the throat and to flow out again into a basin. Use about 2 quarts of the solution at a temperature of 110°, or as hot as it can be borne.

OPERATIVE CASES.—If under a general anaesthetic, laxative the night before, enema in the morning, and a very light breakfast, or none at all if the operation is to be done early. An alkaline mouth wash several

times during the twenty-four hours preceding the operation is advisable.

If under a local anæsthetic, a simple diet for twenty-four hours, with a laxative if necessary. Nervous patients should be given 30 grains of bromide of soda, about an hour before the operation. Ice collar, or cracked ice, to relieve the pain and lessen hemorrhage. If hemorrhage from the tonsils is severe, use squares of gauze wrung out in ice water to make firm compression over the site of the tonsil. Codiene, or morphine, if necessary, to lessen pain. Diet: first day, water, milk, egg-nog; second day, custards, ice cream, eggs, boiled rice, etc. Extend the diet as the throat grows less sensitive. An alkaline mouth wash to be used frequently.

FORMULÆ FOR SIMPLE GARGLES, MOUTH WASHES, AND DOUCHES.—The U. S. Pharmacopœia, under the name *Liquor Antisepticus*, gives a formula that is satisfactory as a mouth wash and gargle. As the solution is slightly acid it is not quite as valuable as the alkaline antiseptic solution.

Liquor Antisepticus Alkalinus, of the National Formulary, is the most generally useful preparation. Diluted with four or five parts of warm water it is suitable for a nasal douche, a gargle, or a mouth wash. Saline solution is also valuable as a douche to the throat or nose.

There are many proprietary preparations on the market that can be used in the same way, but they possess no advantage over the official preparations. The following is a valuable spray, or gargle for the throat:

R Alum powder	10 gr.
Carbolic acid	1 min.
Glycerin	2 dr.
Water	1 oz.

A quarter of a teaspoonful of alum to a cup of water may be used as a gargle. The following is a soothing oil spray for the nose: camphor-menthol, 3 per cent. in white petroleum oil.

THE perfect soldier loves peace, loathes war. No man can be such who cannot, whether alone or among thousands of his fellows, strive, suffer, and wait with magnanimous patience, stake life and fortune, and, in extremity, fight like a whirlwind, for the victories of peace.

GEORGE W. CABLE